# THE ELISON LAB

for Developmental Brain and Behavior Research

Vol 4. January 2021

## HAPPY 2021 FROM THE ELAB!

Big discoveries from little people!

## WHAT'S INSIDE THIS ISSUE?



This newsletter contains updates on active and completed studies in the ELab.

COVID made it necessary to stop most of our in-person data collection, but we were busy analyzing existing data and writing papers about studies that we completed prior to COVID. We also did some online data collection, which was a fun new challenge! You can read details below.

If you have any questions about these studies, or you and your child are interested in participating in ongoing or future studies, email us at elab@umn.edu. We have some remote studies available during COVID.

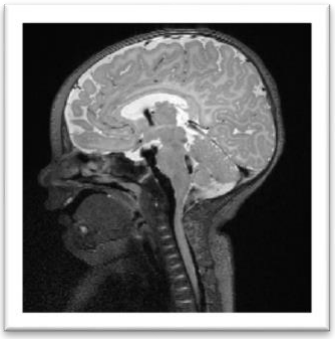
For information about the Baby Connectome Project, email us at babymri@umn.edu.

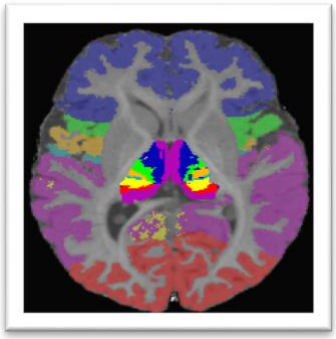
## THE BABY CONNECTOME PROJECT *BRI DAUB & SHARLOTTE IRWIN*

After five years of data collection at the University of Minnesota, the Baby Connectome Project (BCP) has successfully come to an end. BCP data is being shared with the scientific community to provide a better understanding of how the brain develops and impacts behavior from infancy to early childhood. Accomplishments of this project include:

- 186 infant and child participants
- Over 500 in-person and virtual visits
- Over 550 MRI scans
- Over 4,000 surveys completed by parents and families

That is no small feat! Learnings from this project will be used by researchers in papers and projects for years to come. We are so thankful for the many participants who made this project possible. Thank you, BCP families!





## THE BABY CONNECTOME PROJECT – *ENRICHED* *SHARLOTTE IRWIN*

We have officially finished collecting biosamples from our BCP-Enriched participants. In total, we have collected 295 milk samples (over four gallons!), 623 fecal samples, and 887 diet records from moms and babies at the University of Minnesota. We could not have collected this incredible amount of data without you!

So far, we have analyzed milk samples for macronutrients and calories, 26 different Human Milk Oligosaccharides (HMO's), fatty acids, and choline. In the coming year, we plan to do further analyses for cortisol levels, bacterial composition, and immune markers. In fecal samples, we have seen that *Bifidobacteria* are the primary bacteria in your baby's stomach during their first few months.

Now that we have completed data collection, we're working on analyzing our results and writing papers about the connection between milk, bellies, and brains. Be on the lookout for a paper about the connection between maternal anxiety and breast milk!

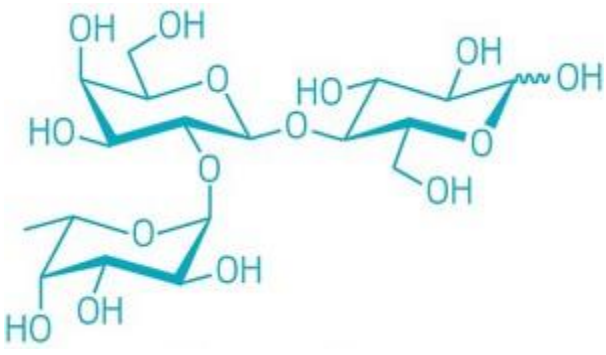
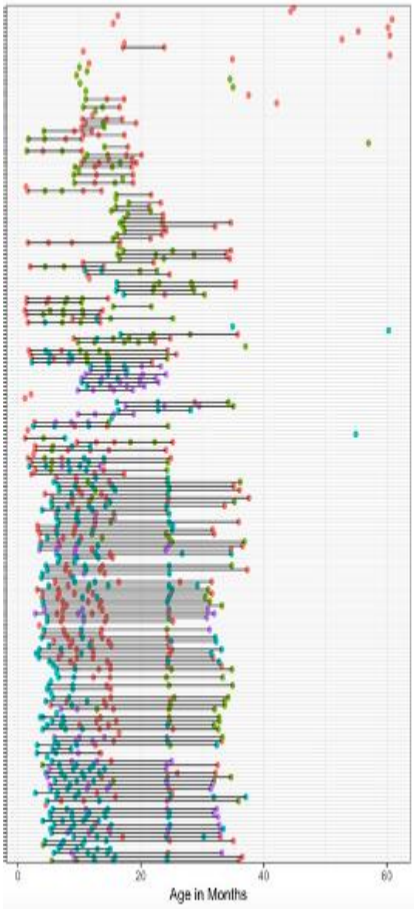



*Figure 1. Human Milk Oligosaccharide (HMO) molecule*

# EYE TRACKING AND EEG *CHARISSE PICKRON & CAROLYN LASCH*

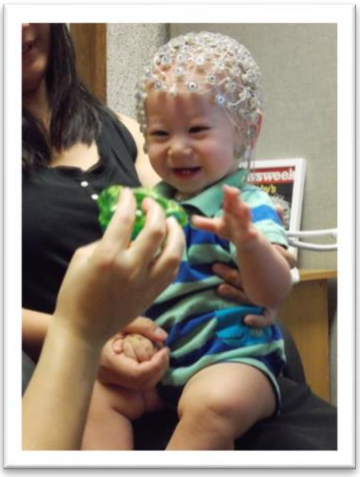



A major part of our research examines how infants and toddlers learn about the social world. This includes learning more about preferences for particular types of images, such as human faces. We explore this by characterizing the types of patterns of eye movement or strategies young children use when they see particular images (e.g., faces vs. scrambled faces, happy vs. sad faces, etc.). In addition to eye-gaze measures, we have started using an electroencephalogram (EEG) to record how the brain responds to pictures of faces expressing different emotions. With EEG we are able to measure neural activity related to changes in attention and how specific areas of the brain (e.g., the visual area) respond to our pictures.

We have been collecting eye-tracking data from participants in our lab for some years now. This spring, a portion of this data spanning almost 100 infants and ages 0-3 years will be presented by our lab at the Society for Research in Child Development (SRCD) meeting in April. To the left is a brief representation of all of the data families have helped us collect, and that we will present this spring.

In our Parent Eye-tracking Study, we hope to learn what parents' looking patterns can tell us about the patterns of their child's social looking and development by examining the differences and similarities between looking patterns from children and their parents. Thank you to all of the families who have continued to fill out questionnaires and complete phone interviews while our in-person visits are on hold! This information is valuable in helping us understand social attention and its development in the first years of life. We are excited to see our families back in the lab as soon as it is safe!

In our Infant Eye-tracking & EEG Study, we hope to better understand the way both eye movement and brain response relate to one another in the context of watching pictures of faces with different emotional expressions. We invited infants between 5 and 6 months of age to participate in our study. Infants sat on their parent's lap wearing a special hat that looked a little like a swim cap. While wearing the hat we were able to record their brain responses. At the same time, we used a special camera to record infants' eye movements. We presented infants with pictures of faces with surprised, neutral, and happy expressions. We have 4 wonderful research assistants, Jessalyn, Jeayong, Kayleigh, and Erica, who are working through the brain activity and eye movement data. Based on early analysis of infants' brain responses, it appears that infants show a distinct attention response when they see surprised facial expressions.



## INFANT BRAIN IMAGING STUDY (IBIS) *TESSA DJIKO*

One of the goals of our research in the ELab is to improve early detection of autism spectrum disorder (ASD). In the US, 1 in 54 children are diagnosed with ASD. In Minnesota, the ASD prevalence rate is higher, with about 1 in 44 children diagnosed with ASD. While the average age of diagnosis is 4 years old, children can start showing early signs of ASD as young as 6 months old. Moreover, families who have one child with ASD have an increased risk of having another child with ASD. Early detection of autism and access to early intervention services is crucial to improving long-term outcomes for these children.

The ELab is a proud member of the IBIS (Infant Brain Imaging Study) Network. The IBIS Network is a consortium of researchers across North America that use a combination of behavioral testing, parent interviews, MRI brain imaging, and EEG to uncover important clues about infant development that can aid in early detection of ASD. Previous research by the IBIS network on infants with older siblings with autism found that MRI brain scans of infants as early as 6 months old can accurately predict later diagnoses of autism.

**The IBIS-EP research study is currently recruiting!** We're looking for families who have a child with autism and a new baby who is 6 months or younger. The goal of our research study is to help improve early identification of autism. Families who participate in our research will visit our lab in-person (or virtually during COVID) when their infant is 6, 12, and 24 months old. Participation at each visit includes infant behavioral testing, parent questionnaires and interviews, EEG, and an MRI brain scan when the infant is naturally sleeping. So far, we have enrolled seven terrific families in the IBIS-EP study! If you or someone you know is interested in participating in the study, please contact us at ibis@umn.edu or visit our website at www.ibis-network.org.

## POPULATION-BASED SCREENING APPROACH TO IDENTIFYING DEVELOPMENTAL DIFFERENCES IN TODDLERS *TESSA DJIKO*

Tons of exciting developmental milestones occur during toddlerhood. This is the time when your child is beginning to actively explore their world through learning how to walk and run, how to communicate their emotions and needs with gestures, words, and sentences, how to pick up small objects and draw, and how to play socially with others, among other key milestones. This is also the time when some children begin to show developmental delays and behavioral patterns consistent with autism spectrum disorder (ASD). Identifying early developmental delays, or "red flags", is crucial so that these children can receive services as soon as possible. The Phenoscreening study investigates whether a population-based screening approach can accurately predict later autism diagnosis at 3 years old. We are having parents fill out online questionnaires about their toddler's behavior and development when their child is between the ages of 17-25 months. From this data, we are able to analyze parents' responses and identify children who are typically developing or could be showing developmental delays that could be an early sign of ASD. Based on questionnaire responses, we are inviting families who have typically developing children and also families who have children who are showing developmental delays or concerning behaviors to participate in COVID-safe virtual visits. We have had over 1,000 families complete our online questionnaires and have seen 134 families for a virtual study visit! Once we feel it is safe to resume in-person testing, we hope to invite families back to visit our lab, too.

**We are still recruiting families to participate in this study!** If you or someone you know with a young toddler are interested in learning more, please contact us at earlychildstudy@umn.edu.

## ASSESSING COGNITION IN 12- TO 24-MONTH-OLD INFANTS *KIRSTEN DALRYMPLE*

When you bring your child to a well-child check-up, your pediatrician will typically assess basic functions such as vision, hearing, breathing, and heart rate, but not cognitive functioning. Yet, we know that early detection of social and cognitive impairments can be critical to early intervention. The purpose of this study is to develop a low-cost, easy-to-use, portable neurocognitive assessment tool for infants and pre-school children. We asked 100 families with 12- and 18-month-old infants to participate in this study. Toddlers watched cartoons on a tablet computer while a small eye-tracking device tracked where they looked on the screen. The cartoons were specially designed to assess executive function, social cognition, number processing, and language. Toddlers also took part in well-established tests of executive function and/or social cognition to help determine whether the cartoons that we designed were providing useful measures of cognitive functioning (i.e., that results from eye tracking match measures from established behavioral tests). The goal is to develop standardized measures of cognitive functioning that are quick and easy to administer and widely accessible. We completed data collection for this study in the Spring and look forward to sharing the results with you next year.

## WHAT DO EARTHQUAKES & YOUR BABY'S LOOKING PATTERNS HAVE IN COMMON? FRACTALS! *ISA STALLWORTHY*

Long before your baby can crawl or walk, they are learning about their world through their eyes! What your baby pays attention to depends on many interacting – and often, competing – processes. For example, sometimes an infant's attention prioritizes things that are perceptually salient, like bright lights or shiny toys. Other times, they can inhibit their attention and choose to look at other things in their environment instead.

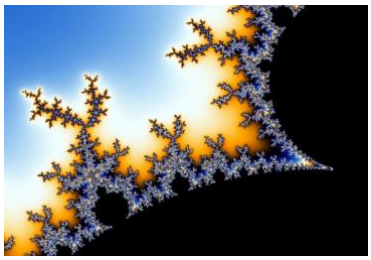


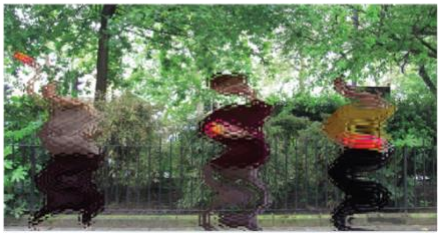
*Figure 1. Example Fractal*

We think that over time, babies' visual attention becomes more self-organized and complex. One way to characterize this complexity is through fractals. Fractals are shapes that exhibit similar patterns at increasingly small scales and appear nearly the same at different levels (Figure 1). They're frequently found in nature, and have been used to characterize heart rates, earthquakes and mountain-ranges. We decided to see if we could characterize infants' eye-gaze patterns using fractals.

A)

*Figure 2. Example Stimuli*

B)



To do this, we showed babies (ages 3-36 months) movies of people dancing (Figure 2a), and versions of the movies with social content removed (Figure 2b). We found that the structure of infants' eye-gaze was, in fact, fractal! Furthermore, over the first years of life, their eye-gaze structure became increasingly fractal. Notably, infants' eye-gaze patterns were more self-organized/fractal when they were watching the movies with social content, compared to the movies with the social content removed. This suggests that infants' attention may be more self-organized when they are more actively engaged with a stimulus, or when a stimulus is more meaningful to them.

You can find our recent publication from this study with more details **here!**

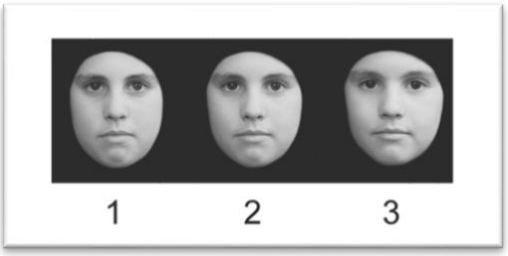
## WHICH SIDE OF THE BRAIN DRIVES OUR EARLY INTEREST IN FACES? *KIRSTEN DALRYMPLE*

Infants show an interest in faces from birth. In both children and adults, face processing happens predominantly in the right side of the brain. In this study, we asked whether the right side of the brain also drives infants' early interest in faces. To answer this question, 3-month-olds were recruited to watch moving schematic faces paired with scrambled faces on a computer screen. Infants were randomly assigned to use both eyes, just the left eye, or just the right eye. Research shows that early in infancy visual information travels mostly from one eye to the opposite side of the brain, so the infants in our study who had both eyes open should process the stimuli with both sides of the brain, while "left eye open" infants should process the stimuli with the right side, and the "right eye open" infants with the left. We found that infants with both eyes open or just their left eye open like looking at faces more than scrambled faces, but the "right eye open" infants have no preference. In other words, infants processing the stimuli with the right side of the brain demonstrate a preference for faces, while infants using the left side only do not! This was particularly true for younger infants (3.00-3.49 months old), than the older infants (3.5-3.99 months old), indicating that the visual system evolves quickly. Importantly, this effect did not hold true to a matched experiment featuring objects, meaning that it reflects something special about faces. So to answer our question: it seems that infants' early interest in faces is mediated by the right side of the brain, the same side that processes faces later in life. We recently published these findings in Developmental Science.

## ARE TODDLERS USING DIFFERENT TYPES OF FACIAL FEATURES TO GROUP PEOPLE TOGETHER? *CHARISSE PICKRON*

One of the goals of our research is to develop a better understanding of how toddlers perceive and reason about the different types of people in their environment. This past year we investigated whether toddlers think about people as belonging to or representing different types of groups. Specifically, we wanted to know whether 1- and 2-year-old toddlers would think that all faces belong to one general human-face group or if they would use subtle facial features (e.g., race and gender) to categorize individuals as belonging to different kinds of groups. We studied this by having toddlers complete an interactive reaching activity. Toddlers saw either 1 or 2 faces of varying features be hidden inside of a box. To assess how many faces toddlers believed to be inside of a box we recorded the number of times and for how long they would reach inside of the box to find a face they believed to be hidden within. We were curious if toddler's reaching would systematically differ based on the number and types of faces they saw be hidden within the box. We found that after seeing 2 different faces be separately shown and then hidden within a box, toddlers reached inside of the box for longer periods of time when they couldn't find the second (hidden) face. Toddlers of both age groups did this type of longer reaching when they saw a human face versus a non-human face go inside of the box. Interestingly, only infants close to 24-months of age showed this longer reaching behavior following the presentation of a male vs. a female face. These findings were recently published in the journal Brain Sciences. We found a slightly different pattern of results for our study that compared White vs. Black faces. We had families come to our lab or meet us at the Minnesota Children's Museum to participate. Our findings indicate that both 12- and 24-month-old infants represent human faces as being distinctly different compared to non-human faces. Additionally, both 12- and 24-month-old infants seemed to make similar distinctions between White and Black faces. This could suggest that as infants become more socially sophisticated, they start to notice and/or make distinctions between faces that differ by race group. Our goal for this research is to further support our understanding of the way infants and toddlers start to think about people varying by social identities.

## FACE RECOGNITION IN SCHOOL-AGE CHILDREN *KIRSTEN DALRYMPLE*




About 2% of the population has a condition called faceblindness (prosopagnosia), which is an inability to recognize faces. Children who are faceblind have trouble recognizing even very familiar people, like their friends, siblings, teachers, or even their parents. It's difficult for children (and even adults) to realize that they have difficulties with face recognition and parents have difficulty determining that face recognition deficits are the reason that their child is struggling socially. To address this issue, we are developing a questionnaire to help evaluate face recognition abilities in children. We have been inviting typically developing children 8-12 years to come to the lab to play some computer "games" of face and object recognition. Children are asked to remember a face and pick it out from a group of faces, or determine whether two faces are the same or different. While children are working on these tasks, parents complete questionnaires about their child's everyday behavior. We plan to relate the results of the face recognition tests to the results from the parent questionnaires to determine whether our questionnaires are useful for evaluating face recognition in children. We have almost completed data collection for this project and will be excited to share the results with you next year.

## FROM OUR GRADUATING PHD STUDENT *ROBIN SIFRE*

An infant sits in daycare when she hears her mother's voice. She immediately stops playing with her blocks, and a flurry of coordinated attention processes begin to coordinate in her brain. She must disengage from the enticing blocks, and search for her mother amidst a room filled with competing distractors. This seemingly simple behavior requires the recruitment – and the coordination of – multiple developing attention processes.

*Coordination* is the organization of different parts of a complex system that enable them to effectively work together. Coordination is essential to cognition, but has been relatively understudied. Research on attention is no exception.

My research takes a systems-level approach to understand how infant attention becomes self-organized and coordinated in the first years of life. My dissertation will be the first study to examine how brain development supports the coordination of these processes that are critical for visual exploration in infancy. Thanks to the Baby Connectome Project, I've spent the past year analyzing MRI and eye-tracking data to understand how brain development supports visual attention, and how it all unfolds in the first years of life. I'm excited to present these findings in a few months at my dissertation defense!

**The ELab sends heartfelt wishes to Robin**
**as she finishes her PhD and embarks on a new adventure outside the lab.**